

App. No. 09/779,788  
RCE Amendment dated 12/8/2005  
Reply to FINAL Office Action of 06/08/2005

*Attn. Docket No. VELCP009C*

**Please replace the ABSTRACT with the Replacement Abstract attached as a separate sheet hereto.**

## Replacement Abstract

### ABSTRACT

~~The current invention provides a~~ A method and apparatus for communicating ~~two or more~~ multi-tone modulated upstream and downstream channels of communication data ~~between a pair of communication devices~~ DMT modulated data within the same ~~utilizing a common set of tones~~ frequency spectrum ~~for the upstream and downstream channels~~. The pair of communication devices each include a digital stage configured to assign mutually orthogonal code sequences for encoding and decoding the upstream and downstream channel respectively. The transmit path of the digital stage of each communication device is configured to generate redundancy in the associated communication data in either the time or frequency domain and to encode the redundant communication data with the mutually orthogonal code sequence prior to transmission thereby allowing the communication devices to share a common frequency spectrum, thus providing symmetrical bandwidth for upstream and downstream communication across of a communication medium ~~for the upstream and downstream communication channels~~. The apparatus may be used for dual channel or multi-channel communications. The method may be implemented on a physical modem or a logical modem with the logical modem including a digital signal processor (DSP) coupled to an analog front end (AFE). The communication medium may include: wired, wireless and optical. Orthogonality in either the time or frequency domains is injected into the individual symbols associated with each DMT tone set or between successive tone sets using a unique code, e.g. Walsh code, assigned to each transmitted channel. The mutual orthogonality of these codes allows two or more channels to be supported in either an upstream or downstream direction using a DMT line code, in connection with any of the various X-DSL protocols including: G-Lite, ADSL, VDSL, SDSL, MDSL, RADSL, HDSL, etc. The present invention provides a signal processing architecture that supports scalability of CO/DLC/ONU resources, and allows a significantly more flexible hardware response to the evolving X-DSL standards without over-committing of hardware resources. As standards evolve hardware may be reconfigured to support the new standards.